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A survey of *Collophora* Richards (Collembola, Collophoridae), with a new species from Brazil and an identification key for the genus

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Abstract

Katiannoidea Bretfeld is a widespread superfamily of Symphypleona that holds taxa with a trochanteral organ on leg III. Collophoridae is a monogeneric family of Katiannoidea composed solely of *Collophora* Richards, and its species are characterized by having 4+4 eyes and a modified capitate bothriotrichum D. The genus has a mostly Holotropical distribution, with species found in the Americas, Africa, and Asia. The overall morphology of *Collophora* remains poorly understood, as most species descriptions are insufficient by current Symphypleona taxonomic standards. In this study, we describe a new species of *Collophora* from northeastern Brazil, characterized especially by its purple body, the presence of ciliated chaetae on the fourth antennal segment, a manubrium with 4+4 chaetae, and a dens with eight dorsal chaetae, four of which are modified into spines. We also provide a bibliographic survey with the diagnoses of all *Collophora* species, an identification key, and a brief discussion on the validity of the families within Katiannoidea, which have never been properly tested using modern phylogenetic methods.

Key Words

Arrhopalitidae, Chaetotaxy, Katiannoidea, Symphypleona, taxonomy

Introduction

Katiannoidea Bretfeld, 1994, is one of the five superfamilies of Symphypleona, characterized by the subanal appendix directed towards the genital opening and the presence of a small modified chaeta inside a large circular, oval, or triangular alveolus—the trochanteral organ—seen at least on leg III (Bretfeld 1994, 1999). This superfamily has a wide distribution across terrestrial habitats of the globe, with its largest family, Katiannidae Börner, 1913, comprising about 200 recognized species of the approximately 360 taxa known for the Katiannoidea superfamily (Bellinger et al. 1996–2024).

Collophoridae Bretfeld, 1999 is a small family of Katiannoidea, represented only by a single genus, *Collophora* Richards in Delamare-Deboutteville & Massoud, 1964a, holding just seven nominal species. The genus has a mainly Holotropical distribution, with species distributed across the Americas, Africa, and Asia, with three, two, and two species for each region, respectively (Bellinger et al. 1996–2024). *Collophora* species are characterized especially by 4+4 eyes—a rare condition within Katiannoidea taxa—together with a capitate bothriotrichum D in the large abdomen, a distinct morphology not recorded in any other group of Symphypleona or other Collembola (Delamare-Deboutteville and Massoud 1964a; Richards 1968; Betsch 1980; Bretfeld 1999).

Initially, species of *Collophora* were described within the genus *Arrhopalites* Börner, 1906, in Arrhopalitidae Stach, 1956, due to their reduced number of eyes,

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subanal appendage facing the genital pore, and the presence of a trochanteral organ. However, Richards in Delamare-Deboutteville and Massoud (1964a) designated a proper genus of Arrhopalitidae for these species due to the distinct circular shape of their trochanteral organ (narrow and oval in *Arrhopalites*), their modified shape of the apex of D bothriotrichum (regular in *Arrhopalites*), and the large abdomen composed of the thorax and abdominal segments I–V (in *Arrhopalites*, the fifth abdominal segment belongs to the small abdomen) (Delamare-Deboutteville and Massoud 1964a). Posteriorly, Bretfeld (1999) removed *Collophora* from Arrhopalitidae and designated its own family, Collophoridae, based on the distinct morphology of the genus.

In this study, we describe the second species of *Collophora* from Brazil, provide an updated diagnosis for the genus, a bibliographic survey of the diagnoses of its species, and an identification key to them. We also briefly discuss the relationships of Collophoridae with other families of Katiannoidea.

Methods

Specimens were preserved in 70% ethanol at 6 °C, clarified in Nesbitt's solution, washed in Arlé's liquid, and mounted on glass slides in Hoyer medium, following Arlé and Mendonça (1982) procedures, with adaptations. The photograph of the habitus of the new species was taken using a Leica EC4 camera attached to a Leica S8APO stereomicroscope under LAS v. 4.12 software. Morphological studies and raw drawings were made with Leica DM500 and DM750 microscopes equipped with drawing tubes. Final figures were processed, enhanced, and arranged into plates using CorelDraw 2022 software.

For our survey of the previously described *Collophora* species, we consulted the original descriptions and redescriptions, if available. For the species distribution, we also checked Bellinger et al. (1996–2024), Mari-Mutt and Bellinger (1990, 1996), and Mari-Mutt et al. (1996–2021). The outlined world map base figure used to depict the *Collophora* species' known distribution was downloaded as a free file from the Cosmographics database website, available at https://www.cosmographics.co.uk/product/free-outline-map-of-the-world/.

The terminology used in the taxonomic description follows mainly Yosii (1976) for the labral chaetotaxy, Betsch and Waller (1994) for the head (including prelabral chaetae) and large abdomen chaetotaxy, Betsch (1997) for the small abdomen chaetotaxy, and Bretfeld (1990) for dorsal dens chaetotaxy. Drawings and observations were based on the entire type series.

The abbreviations used in the descriptions and figures are Th.—thoracic segment(s); Abd.—abdominal segment(s); Ant.—antennal segment(s). Chaetae present or absent are indicated in the figures with white arrows; unpaired chaetae on the trunk are marked with an asterisk. Antennal subsegments are counted from the base to the apex. Chaetotaxy of the head, trunk (thorax + abdomen), and furca is presented for half of the body, with the exception of the prelabral and labral chaetotaxy.

The type series of the new species is deposited in the Collembola Collection of the Biosciences Center at the Federal University of Rio Grande do Norte, Brazil (CC/UFRN) and the Invertebrate Collection of the Instituto Nacional de Pesquisas da Amazônia (INPA).

Results

Order Symphypleona Börner, 1901
Superfamily Katiannoidea Bretfeld, 1994
Family Collophoridae Bretfeld, 1999

Genus *Collophora* Richards in Delamare-Deboutteville & Massoud, 1964a

Diagnosis of the genus. Ant. IV with or without subsegments (up to six subsegments if present). Eyes 4+4. Frontal head and dorsal large abdomen without strong spines or other clear spiniform chaetae. Thoracic segmentation marked. Large abdomen composed of Th. II–III and Abd. I–V, bothriotrichum D with a capitated, somewhat leaf-shaped apex, in a large papilla. Neosminthuroid chaeta present on the parafurcal area. Part of circumanal chaetae on females winged and/or thick. Trochanteral organ present in legs II–III, with a roundish alveolus. Tenent hairs or other strongly modified tibiotarsal chaetae absent. Sacs of the ventral tube relatively short, slightly longer than the corpus, and warty. Unguicular filament equal to or longer than the ungues in all legs. Ventral formula of dens reduced, as 3…1 from apex to basis. Mucro gutter-like with serrated edges, mucronal chaeta absent (revised and updated from Denis 1933, 1948; Delamare-Deboutteville and Massoud 1964a, 1964b; Yosii 1966; Hüther 1967; Richards 1968; Betsch 1980; Bretfeld 1999; Zeppelini and Brito 2013).

Type species. *Arrhopalites quadrioculatus* Denis, 1933.

Remarks. As the family has only one genus, the diagnosis of Collophoridae is the same as that of *Collophora*. Many species of the genus have remarkably limited descriptions, as noted by Zeppelini and Brito (2013; see also Table 1). Most of them lack males in their type series, but it is not possible to determine whether they are parthenogenetic, as in some *Arrhopalites* taxa, due to the small number of specimens (up to five) in their type series and the absence of studies on the biology of the genus (Denis 1933, 1948; Delamare-Deboutteville and Massoud 1964a, 1964b; Yosii 1966; Hüther 1967; Richards 1968; Betsch 1980; Zeppelini and Brito 2013).

Hüther (1967) and Denis (1948) noted the difficulties in separating *C. quadrioculata* Denis, 1933, from *C. subquadrioculata* Denis, 1948. Denis (1948) used the genus diagnostic characters to separate the species, suggesting, for instance, the absence of a capitate bothriotrichum D in *C. quadrioculata*. However, Richards (1968) stated that

Table 1. Main diagnostic characters of *Collophora* species.

Characters/Species	*C. africana*[4]	*C. quadrioculata*[1,7]	*C. mysticiosa*[5]	*C. remanei*[3]	*C. subquadrioculata*[2]	*C. sudanica*[6]	*C. terrabrasilis*[8]	*C. greensladeae* **sp. nov.**
Type locality (country)	Angola	Costa Rica	India	Peru	Vietnam	Sudan	Brazil	Brazil
Color pattern	Purplish blue with diffuse yellow spots	Pale grey	Grayish violet, with violet antennae and pale furca	Entirely brownish gray	Pale gray	Purple reddish, dorsal body and antennae dark purple	Light purple or pink with ventral body, legs and furca pale	Purple, with two longitudinal brownish stripes on large abdomen
Ant IV subsegments	-*	-	3	-	-	-	0 or5	5–6
Ant IV blunt sensillum	+	?	-	+	?	+?	-	-
Ant IV ciliated chaetae	-	?	+	-	?	+	-	+
Labral chaetae formula	?	?	2,3,4	?	?	5,5,4	2,5,4	5,5,4
Labral blunt chaetae	?	?	-	-?	?	3	-	3
Sensilla close to Both A	?	?	?	?	1?	1	1	2
Sensilla close to Both D	1 (leaf shaped)	?	?	?	1	-	2	3
Parafurcal area regular chaetae	?	?	?	?	?	5+5	5+5	5+5
Small abdomen ms1 chaeta (♀)	regular	?	serrated	regular	?	regular	regular	regular
Small abdomen ps1 chaeta (♀)	serrated	?	regular	regular	?	?	regular	regular
Small abdomen ps2 chaeta (♀)	serrated	?	serrated	serrated	?	serrated	regular	serrated
Dorsal anal valve winged chaetae (♀)	2+2	?	3+3	3+3	?	2+2	-	2+2
Ventrolateral anal valve winged chaetae (♀)	1–2+1–2	?	-	3+3	?	3+3	-	1+1
Ventrolateral anal valve thick chaetae (♀)	1+1	?	4+4	-	?	-	3+3	2+2
Trochanteral regular chaetae formula	3/2/2	?	?	3/2/2	?	3/2/2	1/1/1	3/2/2
Femur I spines	2	?	?	-?	?	2	1	2
Ungues I–III tunica	+/+/+	+?/+?/+	+/+/+	+/+/+	-/-/-	+/+/+	+/+/+	-/-/- (♂) -/+-/+ (♀)
Ungues I–III inner tooth	+/+/+	+/+/+	-/-/-	-/-/-	-/-/-	+/+/- (♂) +/+/+?(♀)	+/-/-	+/+/+
Unguiculi I–III inner tooth	+/+/-	-/-/-	-/-/-	-/+/+	-/-/-	-/-/- or -/-/+	-/-/-	-/-/-
Tenaculum chaeta	?	1?	-	?	-	1	1	1
Manubrial chaetae	?	?	3+3	?	?	3+3	?	4+4
Dens basal appendage	+	+	-	+	+	-	-	+
Dens dorsal chaetae	9	9	9	8	9	9	8	8
Dens dorsal spines	7	2	-	-	-	5	3	4
Differences	9/17	3/6	12/17	10/16	5/10	8/22	14/23	

Data based in: [1]Denis 1933; [2]Denis 1948; [3]Delamare-Deboutteville and Massoud 1964a; [4]Delamare-Deboutteville and Massoud 1964b; [5]Yosii 1966; [6]Hüther 1967; [7]Richards 1968; [8]Zeppelini and Brito 2013. Legends: *= described with a weak subdivision not shown in the drawing; + = present, - = absent, ? = unknown/doubtful, Both = bothriotrichum. Last line: differences between the common characters of each species (first number) and the comparable characters of the new species (second number).

this character was present in his revision of the latter species. Due to the lack of many taxonomically informative characters in most of the previous descriptions, such as the detailed chaetotaxy of the anal valves and information about the mouthparts, antennae, and large abdomen (see Table 1), most species of the genus require redescription (Denis 1933, 1948; Richards 1968; Betsch 1980).

Species diagnoses

Collophora africana Delamare-Deboutteville & Massoud, 1964b

Diagnosis. Purplish blue with diffuse yellow spots. Ant. IV with a blunt sensillum, without ciliated chaetae, undivided. One sensilla next to bothriothrica D, leaf shaped. Small abdomen of the female with ms1 as a regular chaeta, ps1–ps2 serrated, with 2+2 dorsal and 1–2+1–2 ventral winged circumanal chaetae. Trochanteral regular chaetae (disregarding the trochanteral organ) formula as 3/2/2 in legs I–III, respectively. Femur I with two spines. Ungues I–III with a single inner tooth and tunica. Unguiculi I–II with an inner tooth, unguiculus III devoid of such structure. Dens with a basal appendage and nine dorsal chaetae, seven of them as spines (adapted from Delamare-Deboutteville and Massoud 1964b).

Collophora quadrioculata (Denis, 1933)

Diagnosis. Pale grey. Ant. IV without subsegments. Ungues I–III with a single inner tooth, at least unguis III with tunica. Unguiculi I–III without the inner tooth. Dens with a basal appendage and nine dorsal chaetae, two of them as spines (adapted from Denis 1933; Richards 1968).

Collophora mysticiosa Yosii, 1966

Diagnosis. Body grayish violet, with violet antennae and pale furca. Ant. IV with three subsegments and ciliated chaetae. Labral chaetae 2/3/4, all regular. Small abdomen of the female with ms1 serrated, ps1 regular, and ps2 as a serrated chaeta, with 3+3 dorsal winged chaetae and 4+4 ventral thick chaetae. Ventral tube with 1+1 chaetae.

Ungues I–III without the inner tooth, but with tunica. Unguiculi I–III without the inner tooth. Tenaculum without chaeta. Manubrium with 3+3 chaetae. Dens without the basal appendage, with nine dorsal chaetae, none of them as spines (adapted from Yosii 1966).

Collophora remanei Delamare-Deboutteville & Massoud, 1964a

Diagnosis. Entirely brownish gray. Ant. IV with a blunt sensillum, without ciliated chaetae, undivided. Small abdomen of the female with ms1 and ps1 regular, ps2 as a serrated chaeta, with 3+3 dorsal and 3+3 ventral winged chaetae, without other ventral thick chaetae. Trochanteral regular chaetae (disregarding the trochanteral organ) formula as 3/2/2 in legs I–III, respectively. Ungues I–III without the inner tooth, but all with tunica. Unguiculus I lacking the inner tooth, unguiculi II–III with the inner tooth. Dens with a basal appendage and eight dorsal chaetae, none of them as spines (adapted from Delamare-Deboutteville and Massoud 1964a)

Collophora subquadrioculata (Denis, 1948)

Diagnosis. Pale gray. Ant. IV undivided. One sensillum close to bothriotrichum D. Ungues I–III without the inner tooth and tunica. Unguiculi I–III without the inner tooth. Tenaculum without chaeta. Dens with a basal appendage and nine dorsal chaetae, none of them as spines (adapted from Denis 1948).

Collophora sudanica Hüther, 1967

Diagnosis. Purple reddish, dorsal body and antennae darker and purple. Ant. IV without subsegments, with ciliated chaetae. Labral chaetae 5/5/4, three of them blunt and thick in line m. One sensilla next to bothriothricum A, bothriothricum D lacking surrounding sensilla. Parafurcal area with 5+5 regular chaetae. Small abdomen of the female with ms1 regular, ps2 as a serrated chaeta, with 2+2 dorsal and 3+3 ventral winged chaetae, without other ventral thick chaetae. Trochanteral regular chaetae (disregarding the trochanteral organ) formula as 3/2/2 in legs I–III, respectively. Femur I with two curved spines. Ungues I–III with tunica, at least ungues I–II with the inner tooth. Unguiculi I–II without the inner tooth, unguiculus III with or without such structure. Ventral tube with 1+1 chaetae. Tenaculum with one chaeta. Manubrium with 3+3 chaetae. Dens without a basal appendage, with nine dorsal chaetae, five of them as spines (adapted from Hüther 1967; Dallai and Mohamed 1981).

Collophora terrabrasilis Zeppelini & Brito, 2013

Diagnosis. Light purple or pink, with ventral body, legs, and furca pale. Ant. IV with 0–5 subsegments (if present, very weakly subsegmented), without blunt sensilla or ciliated chaetae. Labral chaetae 2/5/4, all regular. One sensillum next to bothriothricum A, two sensilla next to bothriothricum D. Parafurcal area with 5+5 regular chaetae. Small abdomen of the female with ms1, ps1, and ps2 as regular chaetae, without winged chaetae, but with 3+3 ventral thick chaetae. Trochanteral regular chaetae (disregarding the trochanteral organ) formula as 1/1/1 in legs I–III, respectively. Femur I with one spine. Ungues I–III with tunica, only unguis I with the internal tooth. Unguiculi I–III without the inner tooth. Ventral tube with 1+1 chaetae. Tenaculum with one chaeta. Dens without a basal appendage, with eight dorsal chaetae, three of them as spines (adapted from Zeppelini and Brito 2013).

New species

Collophora greensladeae Medeiros, Santos & Bellini, sp. nov.

https://zoobank.org/9FD24900-7203-4129-8A77-4792CBADAC1C

Figs 1–4, Table 1

Type material. • Holotype female on slide. Brazil, Piauí state, Altos municipality, "Floresta Nacional de Palmares" (National Forest of Palmares) (5°3'12.53"S, 42°35'36.95"W), in sandy soil, Cerrado biome, 06/IV/2022, Mesquita C. P. col., pitfall traps. Paratypes on slides: three males with the same data as the holotype. The holotype and two paratypes are deposited at CC/UFRN, and one paratype is deposited at INPA.

Diagnosis. Purple, with two longitudinal brownish stripes on the large abdomen. Ant. IV with 5–6 subsegments, with ciliated external chaetae. Labral chaetae 5/5/4, three of them blunt and thick in line m. Bothriotrichum A in a large papilla, with two small surrounding sensilla, bothriotrichum D in a large papilla with three small surrounding sensilla. Parafurcal area with 5+5 regular chaetae. Small abdomen of the female with ms1 and ps1 regular, ps2 as a serrated chaeta, with 2+2 dorsal (mps2–3) and 1+1 ventral (mi3) winged chaetae, plus 2+2 ventral thick chaetae. Trochanteral regular chaetae (disregarding the trochanteral organ) formula as 3/2/2 in legs I–III, respectively. Femur I with two curved and transversal spines. Ungues I–III with the internal tooth, tunica absent in males and unguis I of females, present or absent in unguis II of females, and present in unguis III of females. Unguiculi I–III without the inner tooth. Ventral tube with 1+1 chaetae. Tenaculum with one chaeta. Manubrium with 4+4 chaetae. Dens with a basal appendage and with eight dorsal chaetae, four of them (IIpe, Ip–IIIp) as spines.

Description. Body (head + trunk) length of the type series ranging between 242.45 µm and 542.94 µm, holotype with 542.94 µm, male average size = 264.19 µm, entire type series average size = 333.88 µm. Living specimens somewhat brownish, fixed specimens almost entirely purplish, with two longitudinal brownish stripes on the large abdomen (Fig. 1).

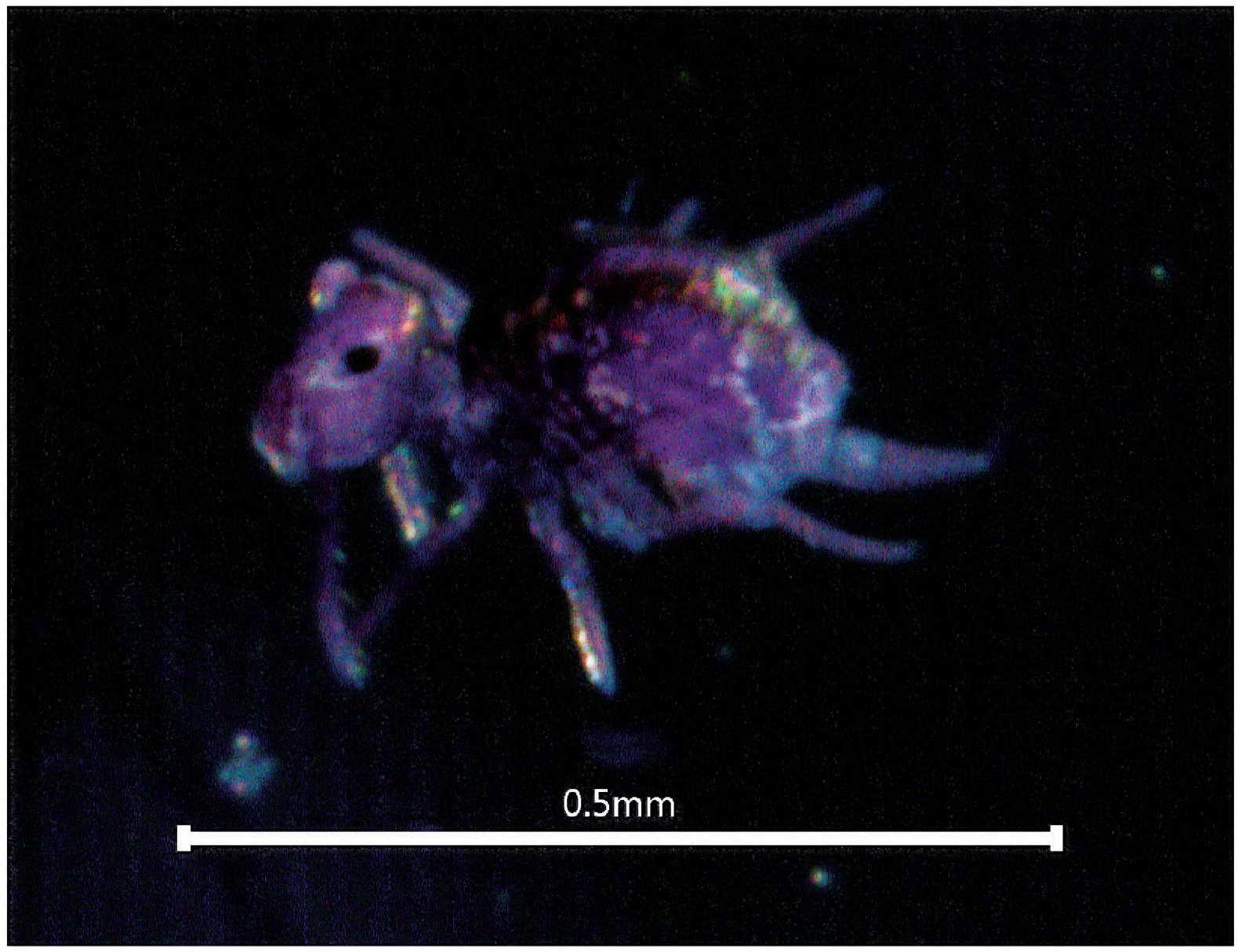

Figure 1. *Collophora greensladeae* sp. nov.: habitus of a specimen fixed in ethanol.

Head (Fig. 2A–D). Antennae length 318.5 µm in the holotype, shorter than body (Fig. 1). Type series antennal segment ratio I:II:III:IV as 1:1.7:2:5.9. Ant. IV with 5–6 subsegments (six in the holotype), chaetotaxy pattern with six subsegments as (from basis to apex): subsegment I (basal) with 8–9, II with five, III with seven, IV with eight, V with 10, VI with 15 chaetae, respectively (Fig. 2A); chaetotaxy pattern with five subsegments as: subsegment I with 14, II with seven, III with eight, IV (apical) with 10, and V with 15 chaetae, respectively. At least all external chaetae of Ant. IV ciliated (Fig. 2A), possibly more, but unclear due to specimens' size. Ant. III with 10 chaetae other than the sensory rods, one of them smaller and spiniform, sensory rods inside a single shallow cavity (Fig. 2A). Ant. II with eight chaetae (Fig. 2A). Ant. I with six chaetae (Fig. 2A). Holotype antennae and head ratio as 1:0.8. Eyes 4+4, with one interocular chaeta, head capsule normal (not elongated) (Fig. 2B). Clypeal area a–f lines with 6/5/4/5/4/1 dorsal + ventral chaetae combined, respectively, 2+2 zones without cuticular granulation next to f line (Fig. 2B). Interantennal area α and γ lines with 1/1 chaetae, respectively, frontal area A–E lines following the formula: 1/1/1/2/2, respectively, cephalic unpaired chaetae absent (Fig. 2B). Six prelabral chaetae present (Fig. 2B, C); labral p, m, and a lines with 5, 5, 4 chaetae, respectively, three of them blunt and thick in line m (Fig. 2C). Labial basal chaetae reduced, basomedian field with three, basolateral field with three chaetae, respectively (Fig. 2D). Mandibles normal (not elongated), with 5+4 incisive apical teeth. Maxilla capitulum spherical, without any clear modifications. Labial papillae formula and guards unclear due to specimens' size.

Trunk (Fig. 3A–D). Large abdomen: Thorax and Abd. I with marked dorsal segmentations. Th. II with one a and one m small chaetae; Th. III with one a sensillum on an invagination, plus one m and one p small chaetae; Abd. I with one a and one m small chaetae; Abd. II with bothriotricha A, B, and C long and aligned. Bothriotrichum A in a large papilla, with four a, three m, and two p chaetae near the bothriotricha, two of them as small sensilla surrounding A bothriotrichum. Abd. III–V with bothriotrichum D in a large papilla plus 11–12 dorsal chaetae and three small sensilla surrounding the bothriotrichum, plus three lateral chaetae next to bothriotrichum C (Fig. 3A). Large abdomen chaetotaxy of males similar to females. Parafurcal area with five regular chaetae and a neosminthuroid chaeta in both sexes (Fig. 3B). Small abdomen: including only Abd. VI in both sexes. Female Abd. VI: dorsal anal valve with as2–3, ams2, ms1–4, mps1–3, and ps1–2 chaetae, ms1 and ps1 unpaired, ms1 and mps1 as large chaetae, mps2–3 as winged chaetae, ps2 serrated; each ventrolateral anal valve with aai1, ai1–6, mi1–5, mpi1–2, and pi1–3 chaetae, mi5 as the subanal appendage, short (not reaching the apex of the ventrolateral anal valve), thick, smooth and pointed, mpi1–2 as large chaetae, mpi2 in a papilla, mi3 as a winged chaeta (Fig. 3C). Male Abd. VI: dorsal anal valve with as2–3, ams2, ms1–4, and ps1–2 chaetae, ms1 and ps1 unpaired; each ventrolateral anal valve with ai1–2, mi1–5 and pi1–3 chaetae, none of them remarkably modified (Fig. 3D). Male genital plate with 7+7 chaetae (Fig. 3E), female genital plate unclear.

Abdominal appendages (Fig. 4A, B). Ventral tube with 1+1 chaetae on the lateral flaps, sacs short and warty.

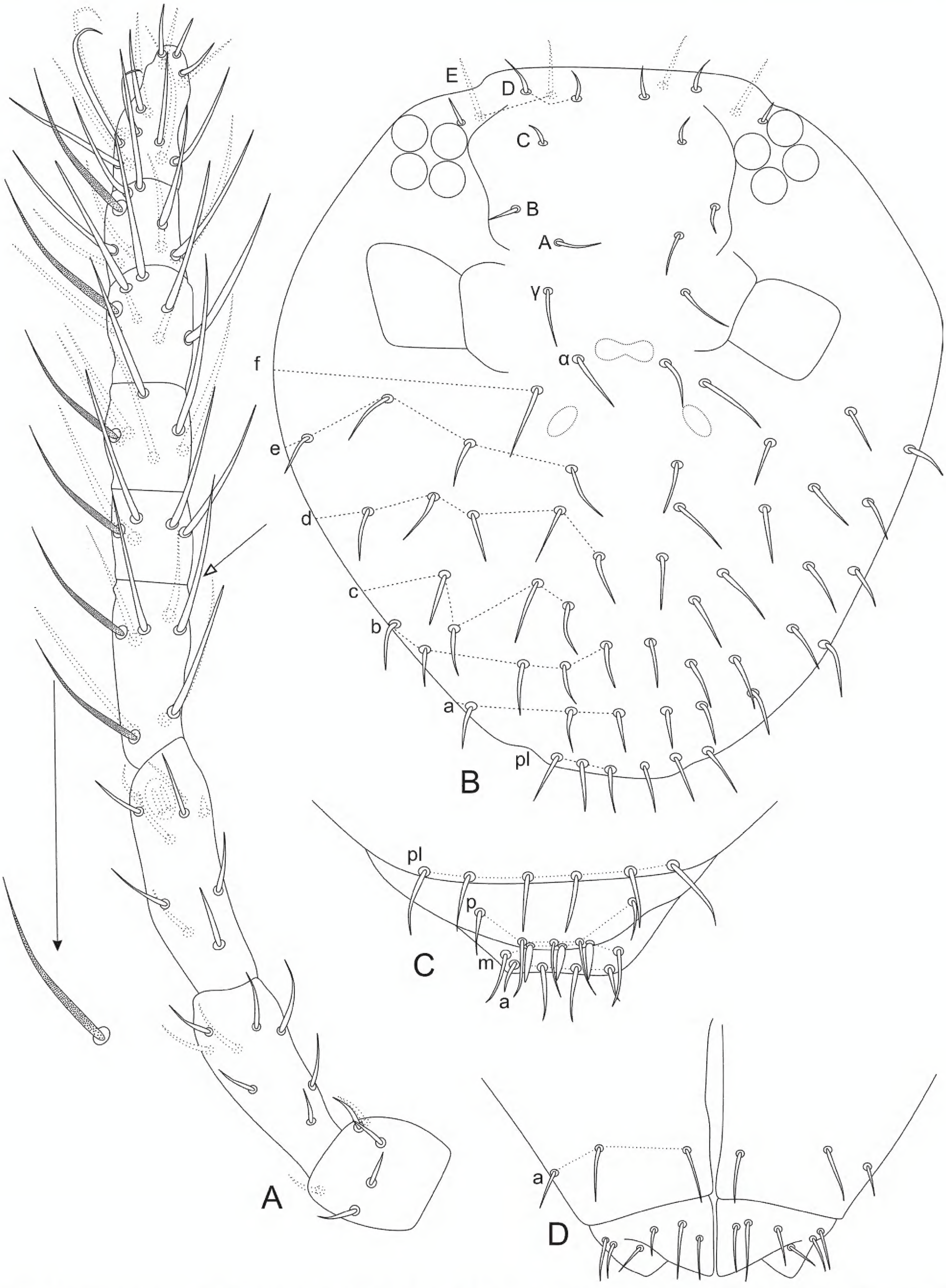

Figure 2. *Collophora greensladeae* sp. nov. head: **A.** Left antenna (dorsal view); the black arrow points to apical ciliated chaeta, and the white arrow points to present/absent chaeta (Ant. IV pattern with six subsegments); **B.** Anterior head chaetotaxy; **C.** Prelabral and labral chaetotaxy; **D.** Ventral head postlabial and basal labial chaetotaxy.

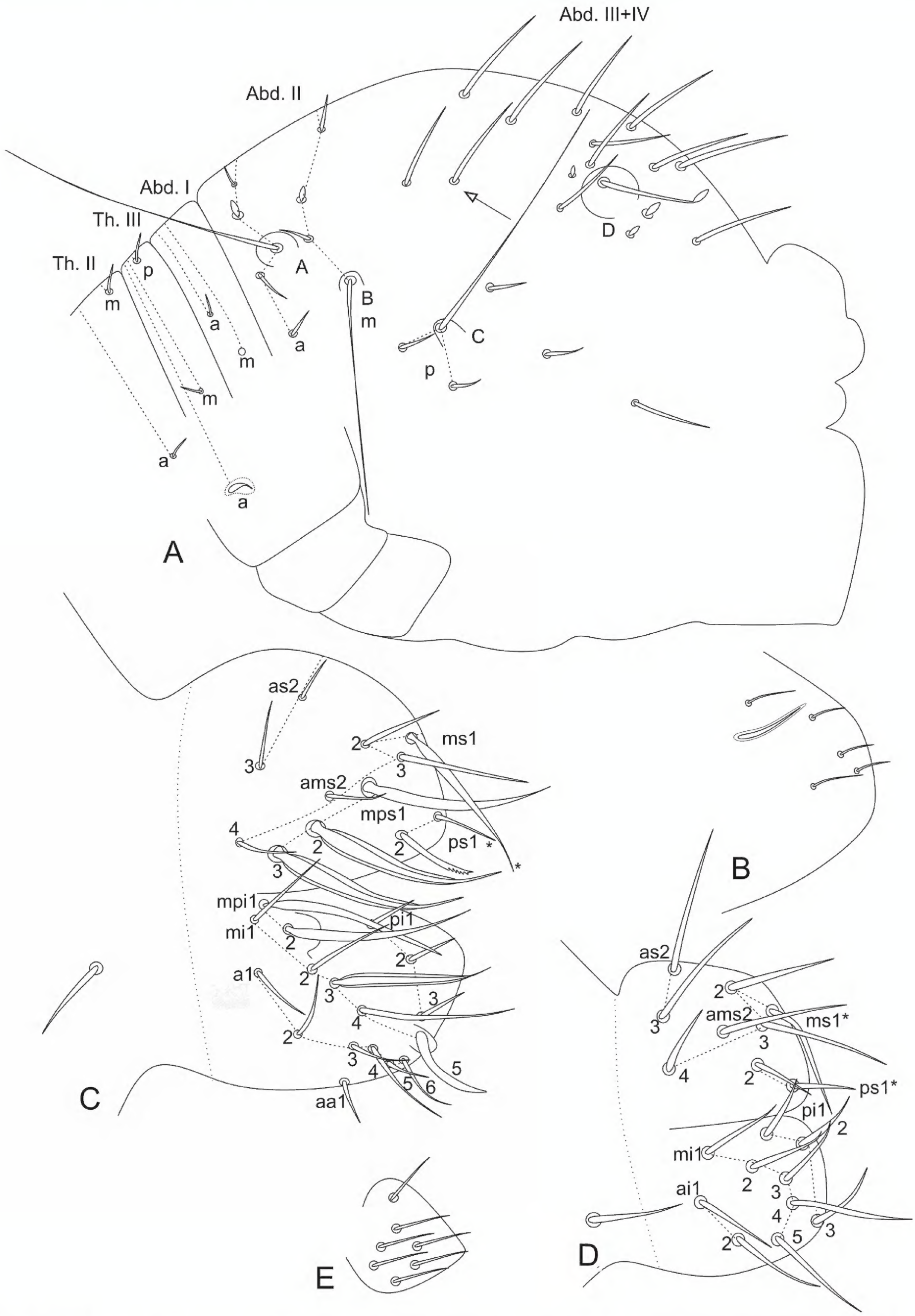

Figure 3. *Collophora greensladeae* sp. nov. trunk: **A.** Large abdomen chaetotaxy; the white arrow points to present/absent chaeta; **B.** Parafucal area chaetotaxy; **C.** Chaetotaxy of the small abdomen of female (* = unpaired chaetae); **D.** Chaetotaxy of the small abdomen of male (* = unpaired chaetae); **E.** Male genital plate.

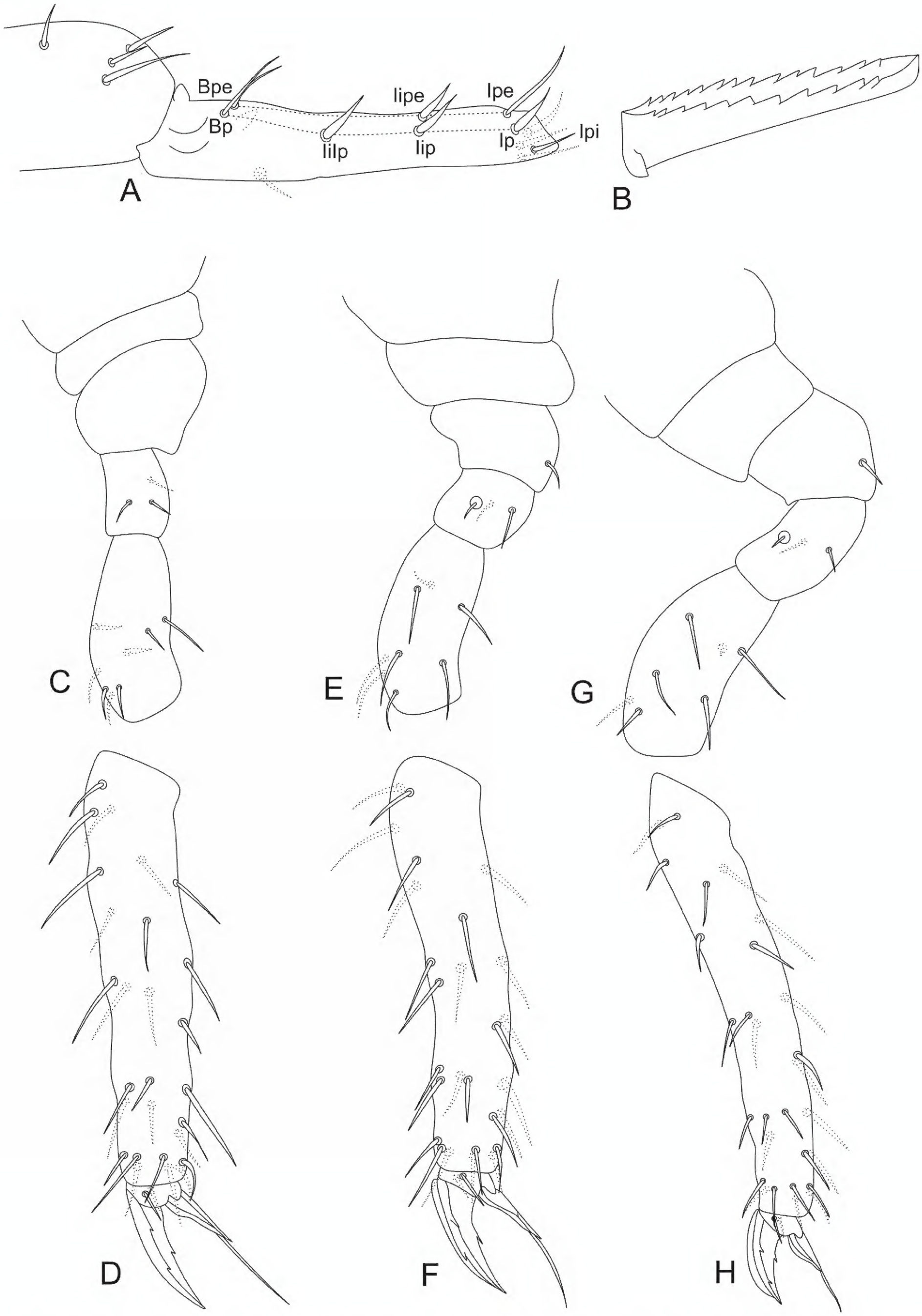

Figure 4. *Collophora greensladeae* sp. nov. furca and legs: **A.** Manubrium and dens (inner view); **B.** Mucro (inner view); **C–H.** Female legs (anterior view): **C–D.** Leg I; **E–F.** Leg II; **G–H.** Leg III.

Tenaculum ramus with three teeth each plus an apically rounded basal appendix, corpus with a single apical chaeta. Manubrium with 4+4 dorsal chaetae (Fig. 4A). Dens dorsally with one basal appendage and eight (posterior) chaetae (Ipe–IIpe, Bpe, Ip–IIIp, Bp and Ipi), four of them modified into spines (Fig. 4A); dens ventrally (anteriorly) with four chaetae, following the formula from the apex to the basis: 3...1 (Fig. 4B). Mucro long, without the apical notch, external and internal lamella serrated, external with about 14 and internal with about 11 serrations, respectively (Fig. 4B). Manubrium: dens: mucro ratio of the holotype = 1:2.2:1.

Legs (Fig. 4C–H). ***Leg I*:** epicoxa, coxa, and subcoxa without chaetae; trochanter with three chaetae and no trochanteral organ (Fig. 4C); femur with two curved and transversal spines and six regular chaetae (Fig. 4C); tibiotarsus with 27 chaetae, nine of them in the apical whorl (Fig. 4D); pretarsus with one anterior and one posterior chaetae, the anterior longer than the posterior one, unguis with one internal and two pairs of lateral teeth, without tunica or pseudonychia in both sexes, unguiculus without tooth, apical filament thin and surpassing the tip of the unguis (Fig. 4D). ***Leg II*:** epicoxa and subcoxa without chaetae, coxa with one chaeta; trochanter with two regular chaetae and one trochanteral organ with a roundish alveolus (Fig. 4E); femur with one short, curved, somewhat spiniform and seven regular chaetae (Fig. 4E); tibiotarsus with 27 chaetae, nine of them in the apical whorl (Fig. 4F); pretarsus with one anterior and one posterior chaetae, the anterior longer than the posterior one, unguis with one internal and two pairs of lateral teeth, females with or without tunica, males without tunica, pseudonychia absent in both sexes, unguiculus without tooth, apical filament thin and surpassing the tip of the unguis (Fig. 4F). ***Leg III*:** epicoxa and subcoxa without chaetae, coxa with one chaeta; trochanter with two regular chaetae and one trochanteral organ with a roundish alveolus (Fig. 4G); femur with one small sensillum and six regular chaetae (Fig. 4G); tibiotarsus with 28 chaetae, nine of them in the apical whorl (Fig. 4H); pretarsus with one anterior and one posterior chaetae, the anterior longer than the posterior one, unguis with one internal and two pairs of lateral teeth, females with, males without tunica, pseudonychia absent in both sexes, unguiculus without tooth, apical filament thin and surpassing the tip of the unguis (Fig. 4H). Ratio of ungues I–III in the holotype = 1:1:1.25.

Etymology. The new species is named in honor of Dr. Penelope Greenslade, who has made many valuable contributions to the knowledge of Collembola.

Habitat. Specimens of *Collophora greensladeae* sp. nov. were collected within shaded forested areas with rocky soil covered by some gravel and dead foliage. The collection site was the National Forest of Palmares, in Altos municipality, Piauí state, northeastern Brazil, within the limits of the Cerrado biome, with some level of influence of the Caatinga and Amazon biomes. It is the same type locality as the recently described *Szeptyckitheca andrzeji* Medeiros, Bellini & Weiner, 2023, and a full description of the area is detailed in Bellini et al. (2023a).

Remarks. *Collophora greensladeae* sp. nov. resembles other South American species, such as *C. terrabrasilis* Zeppelini & Brito, 2013, and *C. remanei* Delamare-Deboutteville & Massoud, 1964a, in having the female anal valve chaetae ms1 and ps1 as regular chaetae and eight dorsal chaetae on the dens. However, it differs from these species in several key characteristics, especially the following: the absence of blunt chaetae on Ant. IV (present in *C. remanei*); the presence of ciliated chaetae on Ant. IV (absent in *C. remanei* and *C. terrabrasilis*); the presence of 2/3 sensilla near bothriotricha A and D, respectively (vs. 1/2 in *C. terrabrasilis*, unknown in *C. remanei*); a serrated female anal valve chaeta ps2 (vs. normal in *C. terrabrasilis*); 2+2 and 1+1 winged chaetae on the dorsal and ventrolateral anal valves, respectively (vs. 3+3 and 2+2 in *C. remanei*, and absent from both valves in *C. terrabrasilis*); and a dorsal dens with four spines (three in *C. terrabrasilis*, none in *C. remanei*).

The new species is also somewhat similar to *C. sudanica* Hüther, 1967, in overall color pattern, labral chaetotaxy, female anal valve ms1 as a regular chaeta and ps2 serrated, and the presence of 2+2 winged dorsal chaetae. However, the new species can be distinguished by several characters: Ant. IV divided into 5–6 subsegments (undivided in *C. sudanica*); bothriotricha A and D each with two and three surrounding sensilla, respectively (one and zero in *C. sudanica*, respectively); the presence of 1+1 winged chaetae on the female ventrolateral anal valve (vs. 3+3 in *C. sudanica*); a manubrium with 4+4 chaetae (vs. 3+3 in *C. sudanica*); and a dens with eight dorsal chaetae, four of which are spines (vs. nine dorsal chaetae, five spines, in *C. sudanica*). For further comparisons, see Table 1.

Identification key and known distribution of *Collophora* species (Fig. 5)

1 With eight dorsal chaetae on dens 2
– With nine dorsal chaetae on dens 4
2 Small abdomen ps2 serrated, trochanters I–III regular chaetae formula as 3/2/2 3
– Small abdomen ps2 regular (smooth), trochanters I–III regular chaetae formula as 1/1/1 .... *C. terrabrasilis* Zeppelini & Brito, 2013 (Brazil)
3 Female dorsal anal valve with 3 winged chaetae per side, each ventrolateral anal valve with 3 winged chaetae, lacking other thick chaetae, dorsal dens lacking spines ..... *C. remanei* Delamare-Deboutteville & Massoud, 1964a (Peru)
– Female dorsal anal valve with 2 winged chaetae per side, each ventrolateral anal valve with 1 winged chaeta plus 2 thick chaetae, dorsal dens with four spines ..... *C. greensladeae* sp. nov. (Brazil)

4 Dorsal side of dens without spines 5
– Dorsal side of dens with spines 6
5 Ungues I–III tunica present, basal appendage of dens absent ..... *C. mysticiosa* Yosii, 1966 (India)
– Ungues I–III tunica absent, basal appendage of dens present .....*C. subquadrioculata* Denis, 1948 (Vietnam)
6 Dens with two dorsal spines, specimens pale gray .....
..... *C. quadrioculata* Denis, 1933 (Costa Rica, Cuba, Mexico, Puerto Rico, USA)
– Dens with five or seven dorsal spines, specimens somewhat purplish 7
7 Ant. IV without ciliate chaetae, female each ventrolateral anal valve with 1–2 winged plus 1 thick chaetae, unguiculi I–II with the inner tooth, dorsal dens with seven spines..... *C. africana* Delamare-Deboutteville & Massoud, 1964b (Angola)
– Ant. IV with ciliate chaetae, female each ventrolateral anal valve with 3 winged chaetae, lacking other thick chaetae, unguiculi I–II without the inner tooth, dorsal dens with five spines.....*C. sudanica* Hüther, 1967 (Sudan and Somalia)

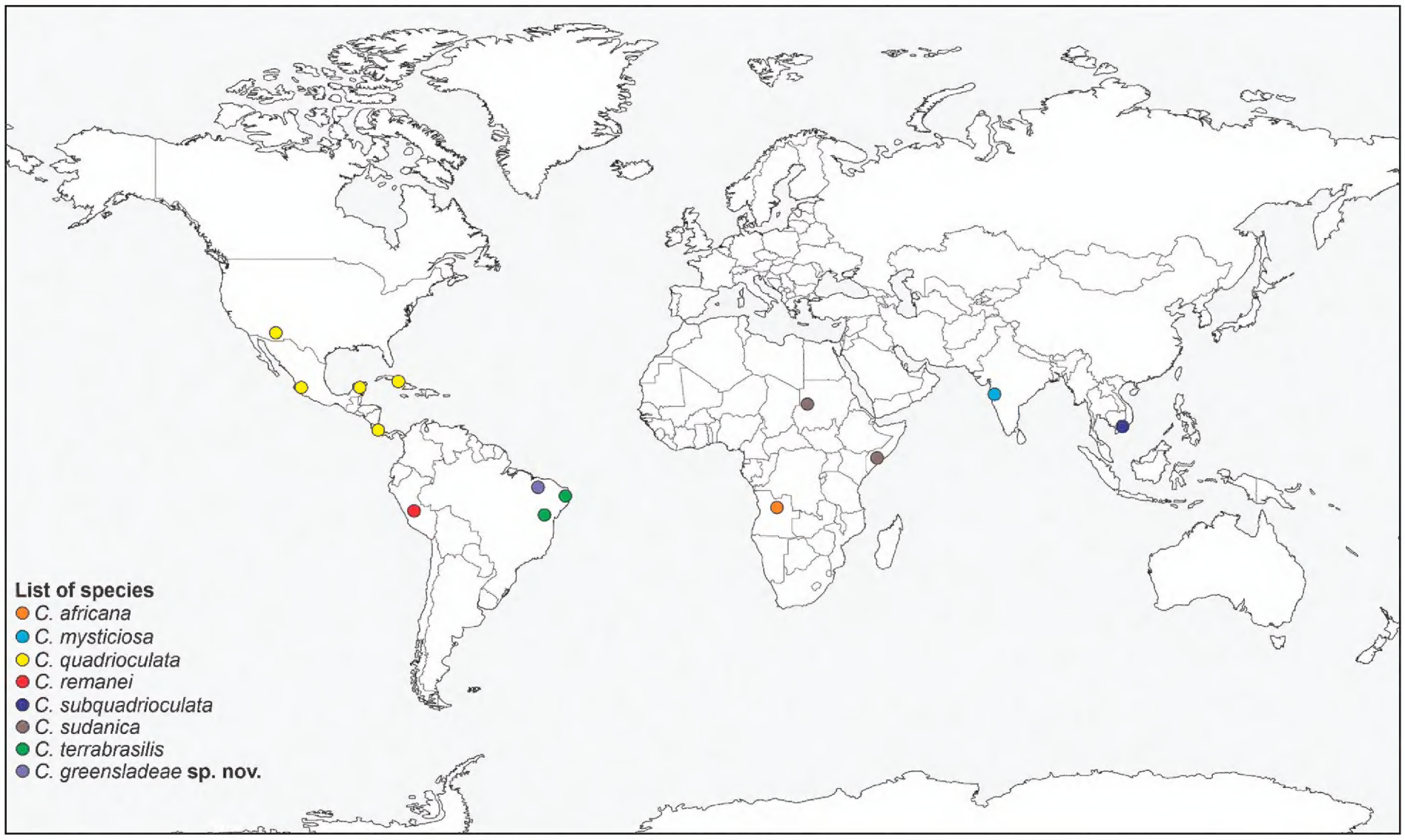

Figure 5. Known distribution of *Collophora* species.

Discussion

The superfamily Katiannoidea currently has four families: Spinothecidae Delamare-Deboutteville, 1961, Katiannidae, Collophoridae, and Arrhopalitidae (Bellinger et al. 1996–2024). These families share a very similar bauplan, with bothriotricha A–D present, the trochanteral organ present at least on leg III (but in many cases present on leg II as well), and the subanal appendage directed towards the genital opening. They differ mainly by characteristics that appear to be linked to adaptations to specific habitats, varying from atmobiotic or epedaphic ecosystems to cave habitats (Bretfeld 1999). Such morphological traits include the reduction of specimen size in many Arrhopalitidae, Spinothecidae, and Collophoridae taxa; reduction or absence of pigments in Arrhopalitidae and Spinothecidae; a decrease in eye number to 0–2 in Arrhopalitidae, 0–4 in Spinothecidae, and four in Collophoridae; and, in some cases, diminution of eye size, as seen in certain cave and euedaphic Arrhopalitidae (Delamare-Deboutteville 1961; Bretfeld 1999). In contrast, the Katiannidae are mostly medium-sized and well-pigmented springtails, holding 6–8 eyes on each side of the head (Bretfeld 1999). The overall morphology of Arrhopalitidae, Spinothecidae, and Collophoridae reflects adaptations to hemiedaphic, euedaphic, troglophilic, and troglobitic lifestyles, whereas the Katiannidae, with all (or most) eye lenses and a large and pigmented body, are represented by epedaphic taxa (Betsch 1980; Bretfeld 1994, 1999; Palacios-Vargas 1999). In this context, it is likely that taxa with reduced body size, reduced number and/or size of eyes, and reduced pigmentation may represent divergent specialized lineages of Katiannidae, suggesting that this family is a paraphyletic taxon. So far, no study employing modern methods to investigate the internal affinities of Symphypleona (e.g., Bellini et al. 2023b; Godeiro et al. 2025) has been able to properly assess the validity and relationships of the internal lineages within Katiannoidea, primarily due to limited sample size. For instance, it is not clear whether underground life adaptations emerged more than once

within Arrhopalitidae and Spinothecidae, or whether Arrhopalitidae, Spinothecidae, and Collophoridae are more closely related to one another than to Katiannidae. Therefore, it is necessary to reassess Katiannoidea using phylogenetic methods in order to properly test these hypotheses.

Conclusion

In this study, we described a new species of *Collophora*, *C. greensladeae* sp. nov., with a unique set of characters, especially regarding the antennal, large abdomen, and furcular chaetotaxy. It represents the second nominal species of *Collophora* recorded from Brazil, the fourth from the Neotropical Region, and the eighth for the entire genus. Most previously described taxa require revision and redescription due to very brief and less informative descriptions by current standards of Symphypleona taxonomy. Even so, we were able to present a survey of the current taxonomical knowledge of the genus, including an identification key, which may guide future studies on Collophoridae. Finally, we noted that the families within Katiannoidea must be properly tested using modern phylogenetic methods, since at least Katiannidae may represent a paraphyletic taxon.

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